DEFENCE

MELLMAN

Wellman Group

WELLMAN DEFENCE — Defence Equipment, Hydrogen Equipment

WELLMAN FURNACES — Furnaces

WELLMAN GRAHAM — Heat Exchangers

WELLMAN PROCESS ENGINEERING — Condensers & Evaporation Equipment

WELLMAN ROBEY — Industrial Boilers

Group Structure

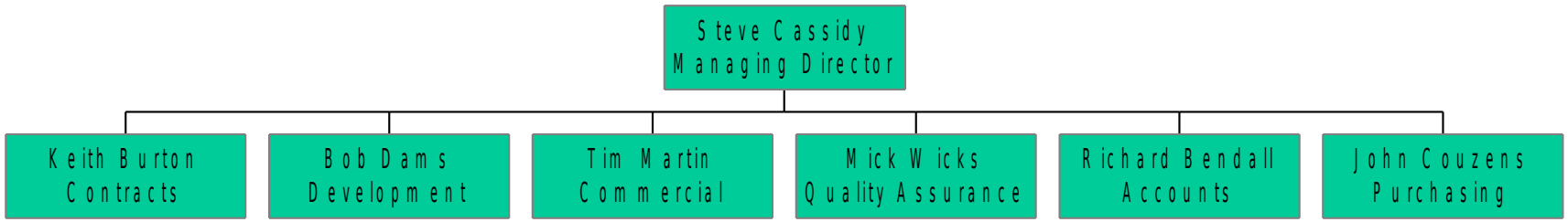
Group Turnover ~£50M

No. Employees ~500

Wellman Defence History

- 1957
  - Formation of CJB Research Station
- 1963
  - Formation of CJB Special Contracts Group
- 1971
  - Formation of CJB Developments Ltd. from merger of CJB Research Station and CJB Special Contracts Group
- 1997
  - CJB Developments Ltd. became Wellman CJB Ltd.
- 2001
  - Formation of Wellman Defence Ltd. from merger with the defence section of Wellman Process Ltd.

Wellman Defence Management Structure



Wellman Defence Limited

- Turnover - ~ £ 5.6 million
- No. Employees - ~ 60

Wellman Defence Interests

- Defence Equipment
- Fuel Processors
- Hydrogen Generators
- Hydrogen Purifiers

Wellman Defence Products

- Air purification equipment for submarines
- Oxygen generators for aircraft carriers
- Hydrogen purification and generation systems for industrial applications
- Fuel cell systems and reformers for defence and industrial applications

Air Purification Equipment for Submarines

- High Pressure Electrolyser
- Low Pressure Electrolyser
- CO_2 Removal Unit
- Refrigerant Removal Unit
- Gas Management Plant
- CO/H_2 Burner

Defence Exports

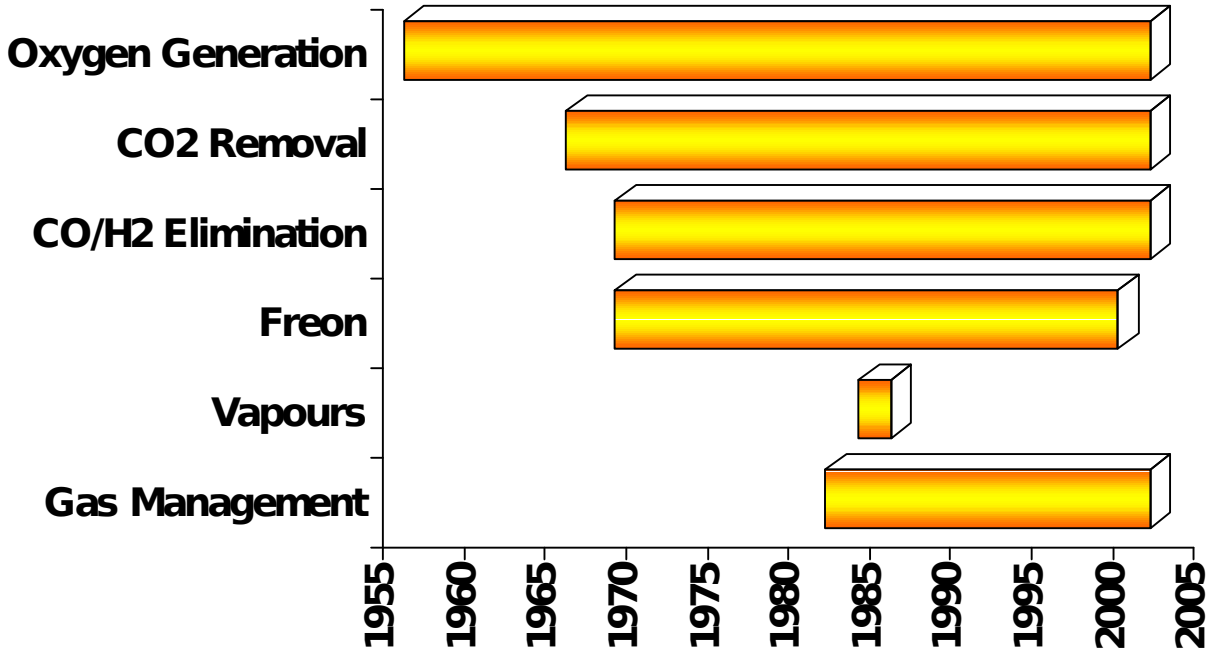
France
- High Pressure Electrolyser
- Logistic Support

Australia
- CO/H_2 Burner
- CO_2 Removal Unit

Canada
- CO/H_2 Burner

Sweden
- CO/H_2 Burner

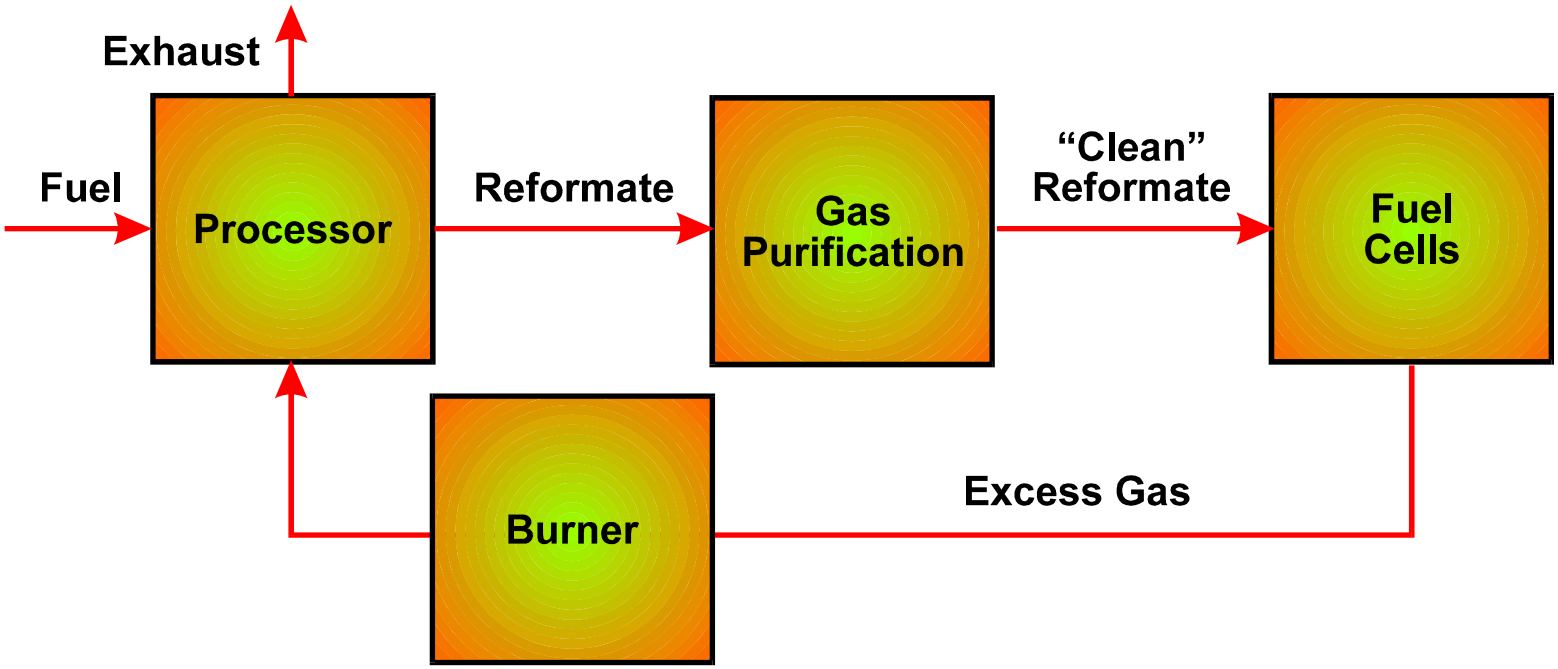
Submarine Equipment Programmes



Fuel Cells

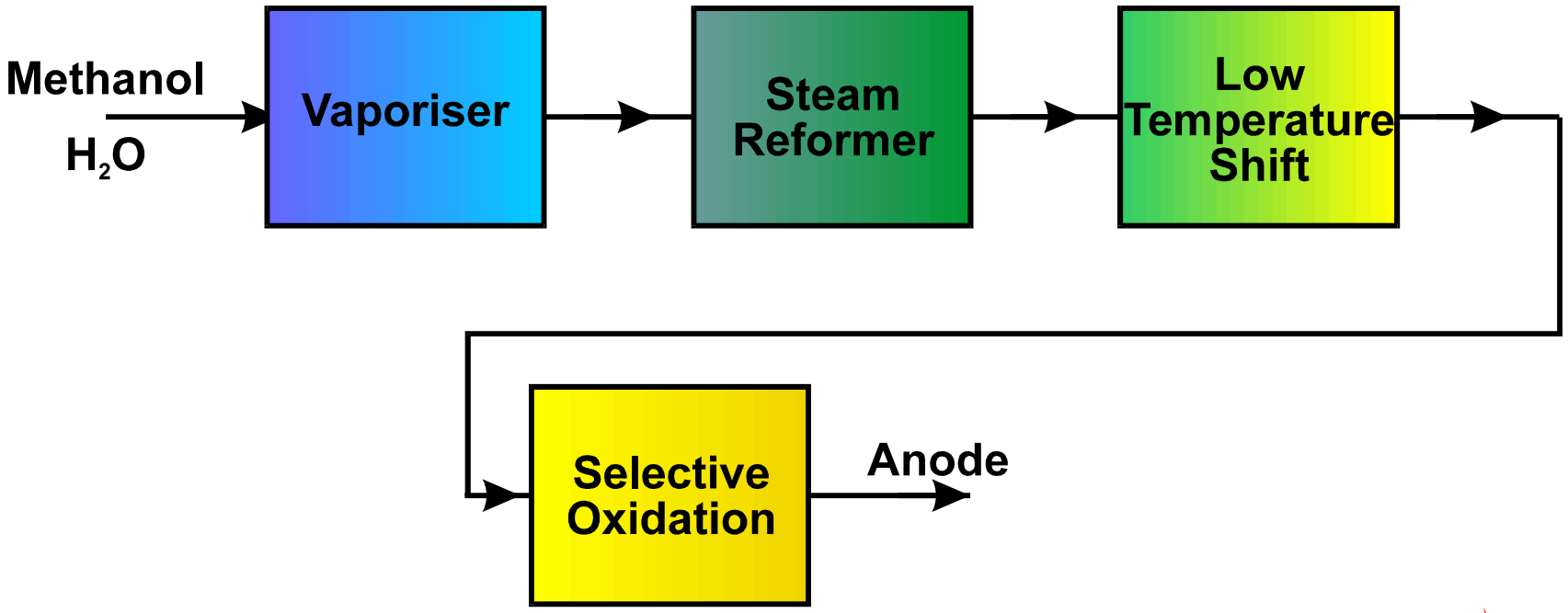
- 1960 MoD - AIPS Study Alkaline Fuel Cell
- Late 1980's MoD - AIPS Study PEM Fuel Cell
- Late 1980's ESA/Dornier - RFC System for Spacecraft
- 1990 CJBD/VSEL - Fuel Cell Collaboration
- 1995/6 MoD - Marine Fuels Studies (2 Off)
- 1996 EC - MERCATOX JOULE Programme
- 1996 DTI - Liquid Hydrocarbons Studies (2 Off)
- 1998 EC - COCLUP/HYSEP JOULE Programme
- 1999 DTI - Long Term Testing
- 2000 MoD - Logistic Fuel Processing

Fuel Processing for PEM Fuel Cells -Typical System

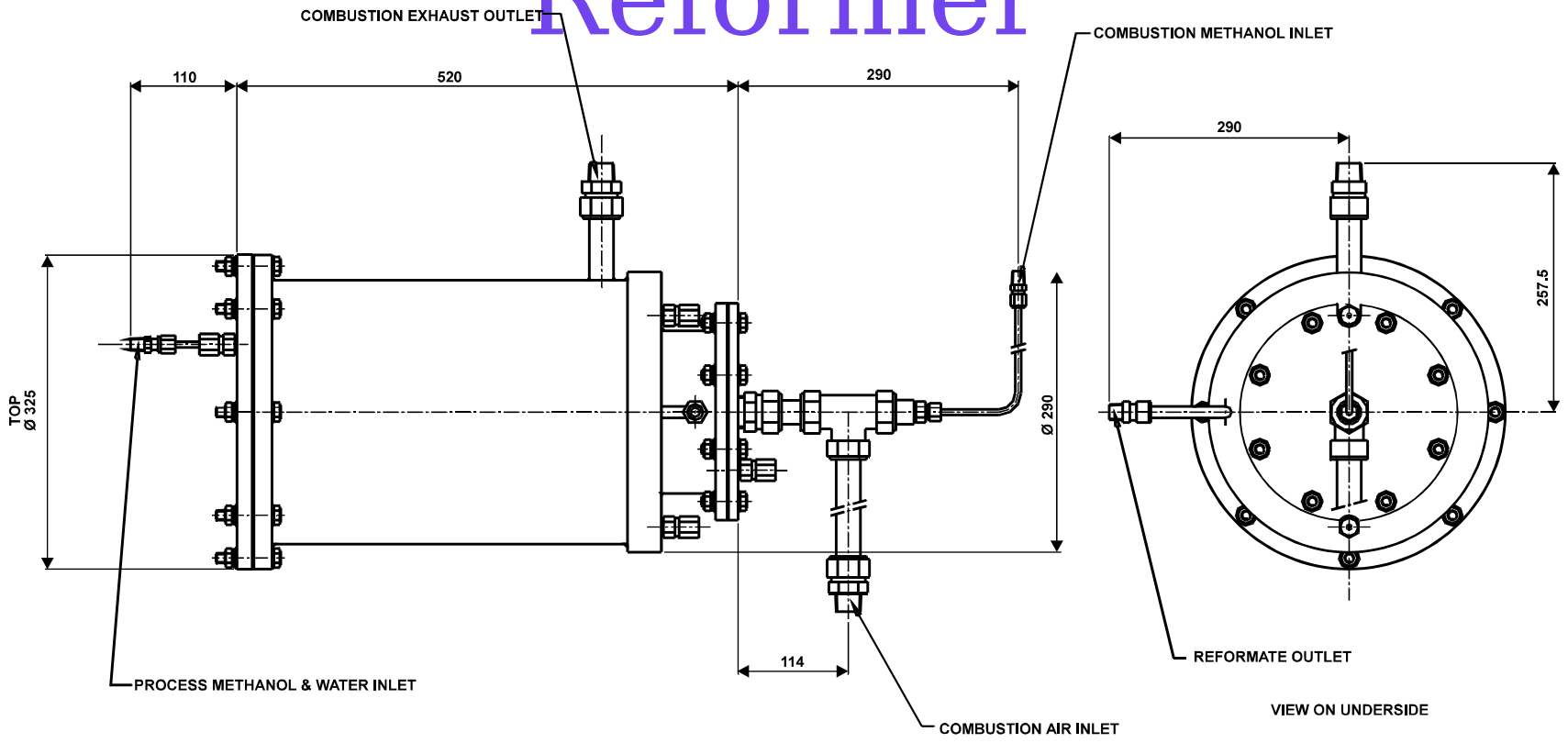


Fuel	:	**Methanol**
Reformate	:	**75% H_2, 24% CO_2, 1% CO**
"Clean" Reformate	:	**75% H_2, 25% CO_2, 2ppm max CO**

Steam Reforming of Methanol



Packed Bed Methanol Reformer



DIMENSIONS IN MILLIMETRES

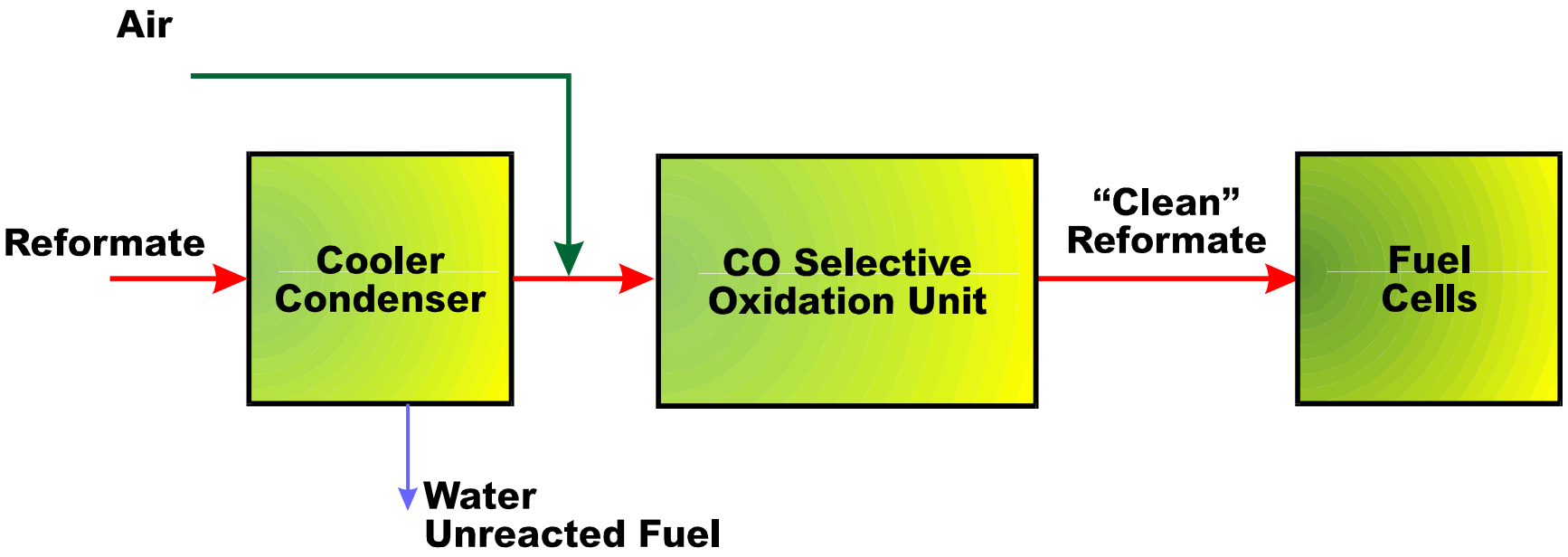
Packed Bed Methanol Reformer- Details

- 7kW
- 200 l/min reformate
- 75% H_2, 24% CO_2, 1% CO
- 250 ºC
- Start-up ~15 min
- Response time ~ 1 min

CO Selective Oxidation

- Catalytic with injection of air/oxygen
- Highly selective catalyst
- Preferentially oxidises CO to CO_2
- Requires control
- Single stage
- Reduces CO to less than 2 ppm

CO Selective Oxidation Simplified System Diagram



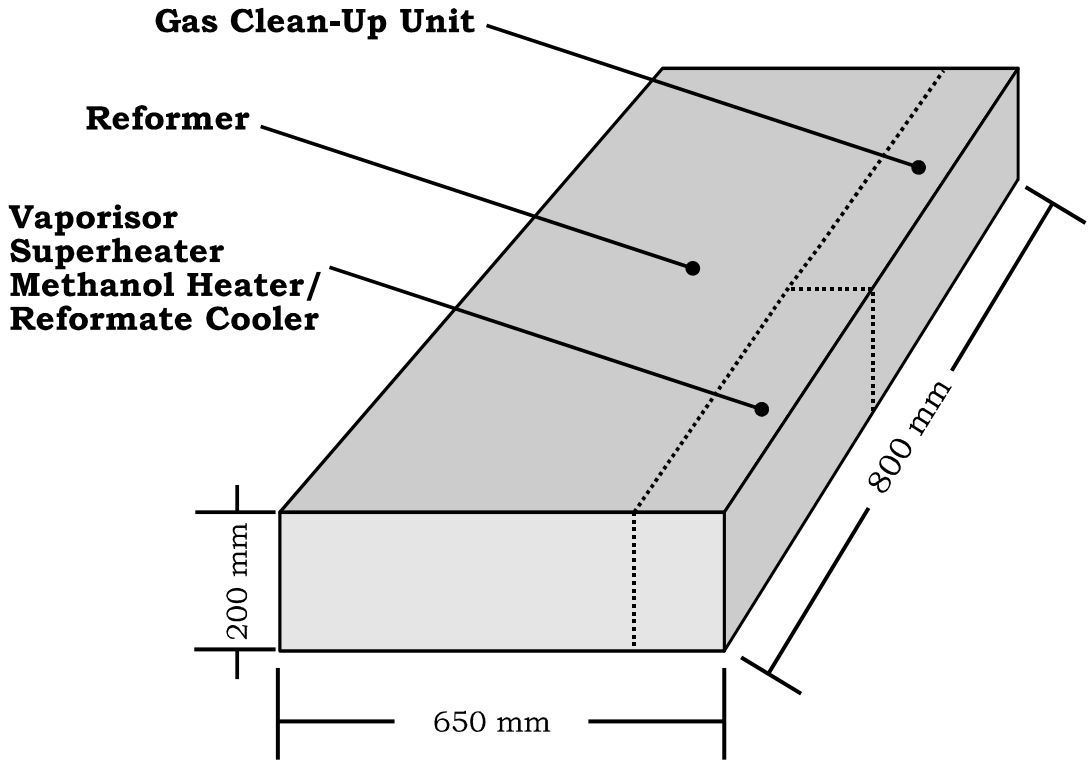
CO Selective Oxidation Performance

- Inlet :75% H_2, 0.5% CO, Balance CO_2
- Outlet :75% H_2, 2ppm CO, Balance CO_2

MERCATOX
European Community JOULE Project

Development of a compact methanol reformer and gas clean-up unit for a PEMFC car

Volume - Outline Concept
50 kW PEMFC
MERCATOX Processor



COCLUP/HYSEP
European Community JOULE Project

- Develop thin film Ag/Pd membrane
- Ceramic support
- Low cost
- Suitable for PEMFC car

DESULPHURIZATION STEP

- Amine wash
- Hydrodesulphurization
- Activated carbon
- Zeolites
- Purisol
- Selexol
- Rectisol
- Zinc Titanate

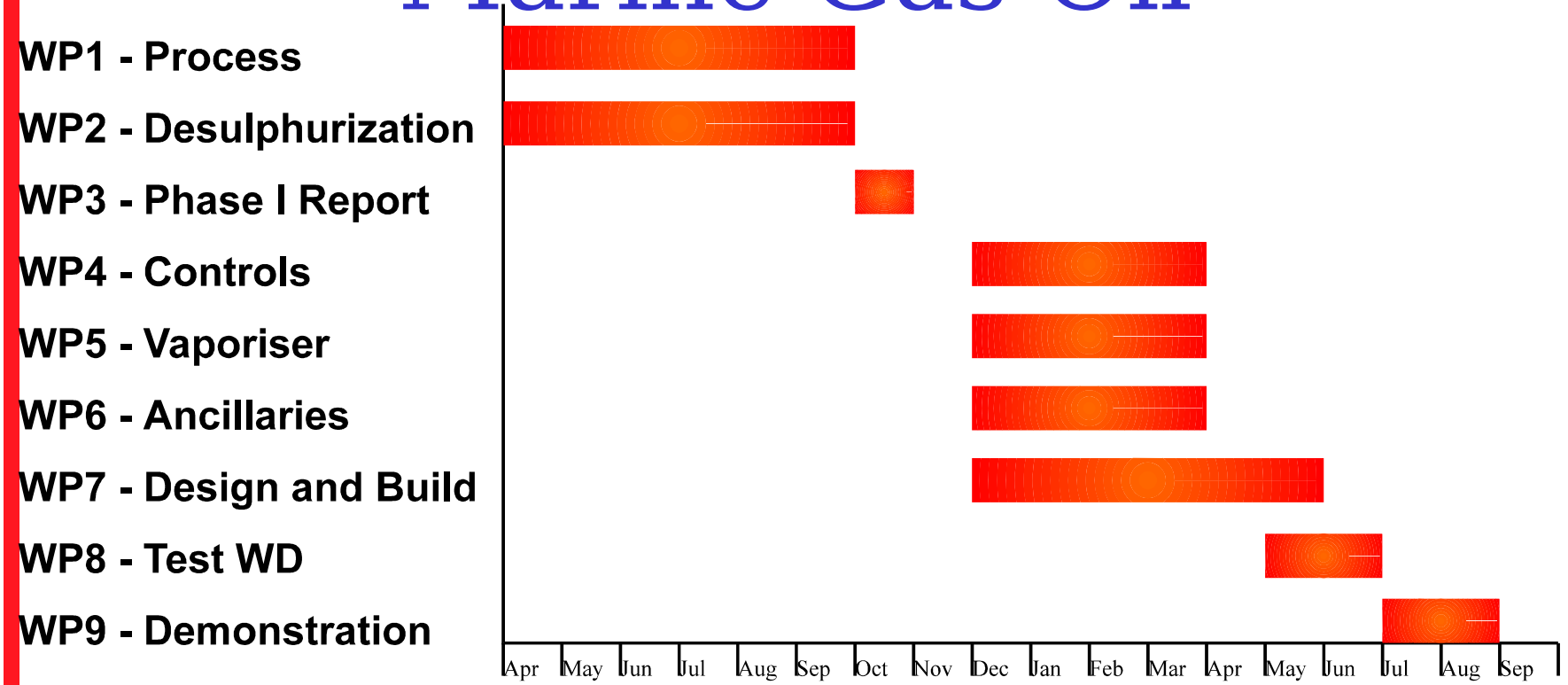
- Zinc oxide
- Iron oxide
- Activated Alumina

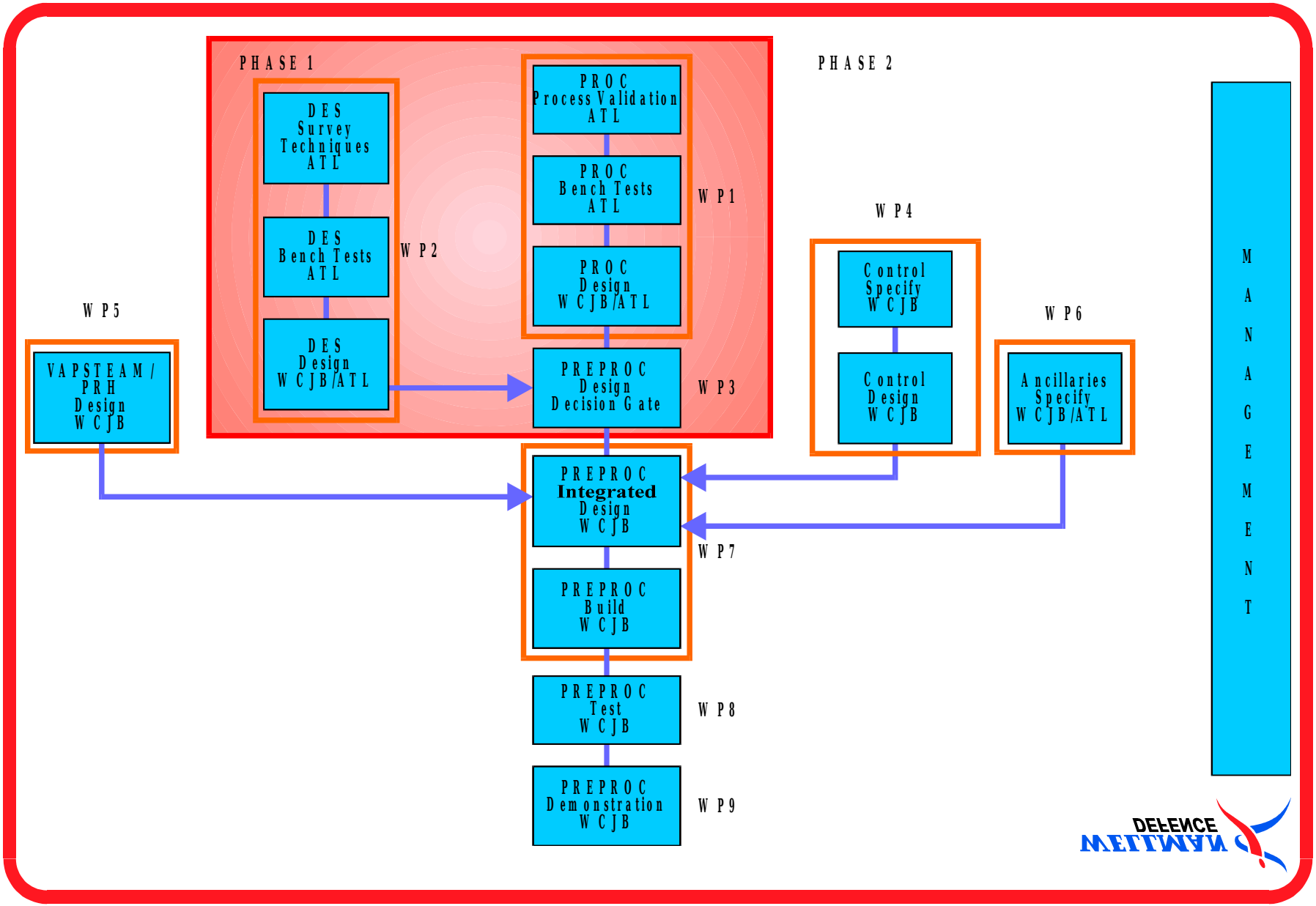
Initial (Front End) Processing Step

- Thermal Cracking
- Thermal Hydrogenation
- Gas Recycle Hydrogenation
- Catalytic Cracking
- Catalytic Hydrocracking

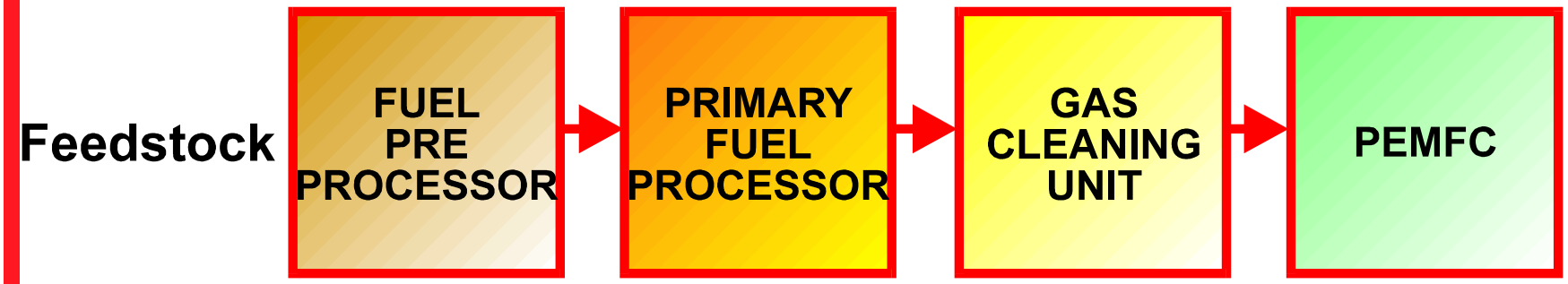
- Steam Reforming
- Partial Oxidation
- Autothermal Reforming

Fuel Pre-Processor for Marine Gas Oil

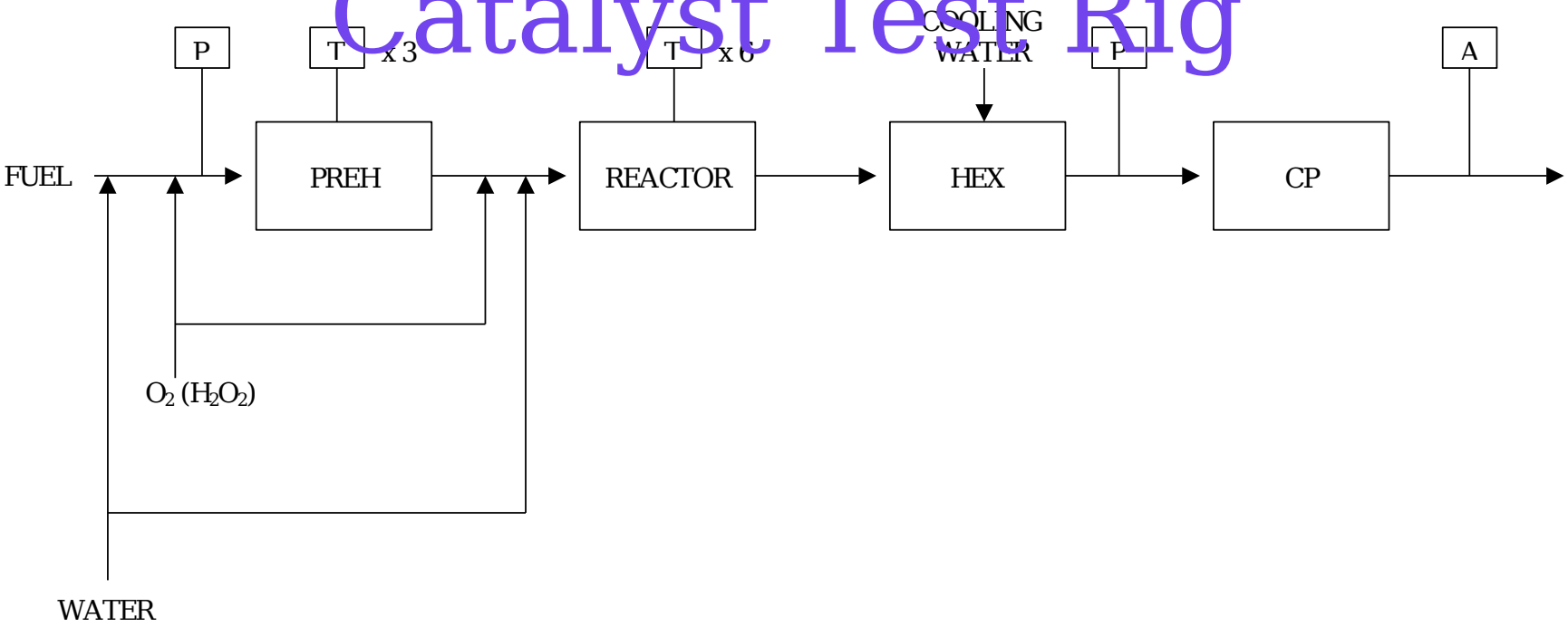



PHASE 1
PHASE 2
DES Survey Techniques ATL
DES Bench Tests ATL
DES Design WCJB/ATL
WP2
PROC Process Validation ATL
PROC Bench Tests ATL
PROC Design WCJB/ATL
WP1
PREPROC Design Decision Gate
WP3
WP5
VAPSTEAM / PRH Design WCJB
WP4
Control Specify WCJB
Control Design WCJB
WP6
Ancillaries Specify WCJB/ATL
PREPROC Integrated Design WCJB
WP7
PREPROC Build WCJB
PREPROC Test WCJB
WP8
PREPROC Demonstration WCJB
WP9
MANAGEMENT
DEFENCE
MELLMAN

Marine Fuel Processor Block Diagram

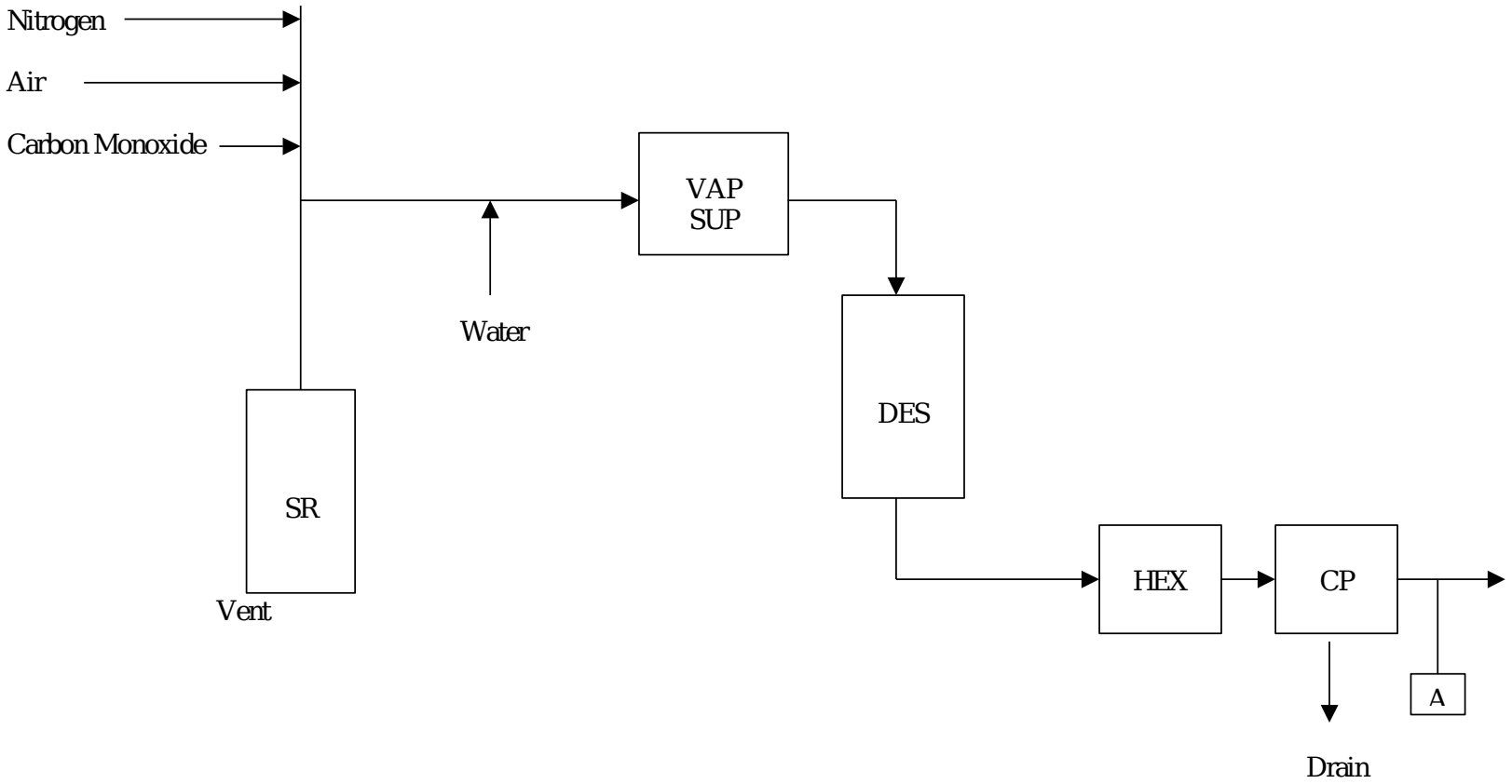


Steam Reforming/Autothermal Catalyst Test Rig



PREH : Preheater
HEX : Heat Exchanger
CP : Catch Pot
H_2O_2 : Hydrogen Peroxide

Desulphurization Test Rig



SR	Simulated Reformate
VAP/SUP	Vaporiser/Superheater
DES	Desulphurizer
HEX	Heat Exchanger
CP	Catch Pot
A	Analyser

Facilities

- Design Offices
- Laboratories
- Development Areas
- Cleanroom
- Instrument Shop
- Workshops
- General Offices

Personnel

- 23 Engineers and Technical Staff
- 18 Shop Floor
- 10 Office Staff
- 7 Management

Capabilities

- Studies
- Prototype development and test
- Design
- Manufacture
- Installation and commissioning
- In service support

Quality Assurance

- BS EN ISO 9001 including limited software

Documentation

- Maintenance
  - IPC - Illustrated Parts Catalogue
  - BR - Book of Recommendations
  - AESP - Army Equipment Support Publication
  - PMS - Planned Maintenance Schedule
  - JIC - Job Information Card
  - TF - Test Form
- Spares
  - SDF 60
  - SDF 73
  - DEFCON 82 (A&B)

Training

- Bespoke courses to suit client requirement
- In-house / client premises

Field Maintenance

- Site Engineers
- Head Office Engineers

Solutions to Technical Problems

- Engineering Capability
  - Process/Chemical
  - Mechanical
  - Electrical
  - Control and Instrumentation
- GRC Consultants

Modifications

- Enabling arrangement for modification / support
  - Sore thumbs
  - Obsolescence
  - Investigations

WELLMAN
Submarine Atmosphere Control System